

**Attachment 1 – Scope of Services**  
**PEASE WWTP**  
**UV DISINFECTION PILOT STUDY**  
**PROGRAM PROTOCOL**

**1. Objective**

The objective of the pilot is to determine if UV disinfection will be susceptible to the same disinfection problems that the current chlorination system has experienced and to obtain data that can be used to establish the required design parameters for a full scale UV disinfection system to replace the existing chlorine disinfection system. Specific evaluations will include:

- The ability of the UV disinfection system to disinfect a variable wastewater characteristic that has Product 5023 with HEPES and Product 5024 with TRIS.
- The effect of wastewater characteristics and variability observed during the pilot study on the UV system disinfection performance, with emphasis on UV Transmittance and solids.
- Determination of the UV dosage required to meet current effluent permit requirements for *Fecal Coliform* of 14 # / 100 mL geometric mean and 43 # /100 mL max day, at the effluent quality characteristics which occur during the pilot and a worst case UVT of 60%.
- Determine the ability of the UV disinfection system to meet a potential future NPDES permit requirement that includes enterococci bacteria limits for swimming areas. Although no limit is proposed, the NHDES has indicated that in swimmable areas an enterococci limit of 35 per 100 ml may be imposed.

**2. Schedule**

The pilot study will be performed over an approximate 2-month period between July and October 2005, weather permitting. The date of harvesting Product 5023 (with HEPES) and Product 5024 (with TRIS) is critical to the pilot program and will dictate the schedule. Lonza Biologics shall provide the exact dates for harvesting events.

### **3. Equipment**

The attached pilot plant equipment specification describes the equipment to be used. The main system components and the parties responsible are:

#### By TrojanUV

- Influent flow meter and data logger, 0-300 gpm range
- Pre-assembled open channel, low pressure low output UV reactor equipped with continuously recording online UV sensor, requiring only connection to influent and effluent piping and power

#### By City

- Submersible pump capable of providing a variable flow rate of approximately 0 - 150 gpm to the UV pilot system.
- Piping, valves and supports for pump feed system and UV pilot unit
- Metering pump, piping and materials to vary UVT
- UV Transmittance Meter
- Turbidity Meter with continuous recording if possible
- Power to UV unit per TrojanUV quote, power to the system feed pump
- Algae control of feed to UV unit by covering the equalization tanks and pilot unit or other acceptable means
- Sampling during the pilot test for all parameters as shown in Table 1 attached.
- Operation and maintenance of the pilot system during the pilot test

### **4. Wastewater characterization program**

The attached Table 1 specifies the proposed parameters and frequency for collecting samples of influent and effluent to the pilot system for analysis to identify characteristics which may influence the performance of the UV pilot system. The goal of the characterization program is to establish the range and variability of the influent water quality that occurs during the pilot study, and identify how that variability impacts the pilot system disinfection performance. The main wastewater parameters to be monitored are:

- Flow rate to UV Pilot Unit

- UV Transmittance
- Total suspended solids
- Turbidity
- Influent and effluent *Fecal Coliform* and *enterococci*. All fecal coliform samples from the pilot plant should be collected and analyzed in duplicate to allow statistical comparisons of the data.
- Potential sleeve fouling agents (iron, manganese and hardness)

## 5. Pilot plant runs

Wastewater characteristic data obtained during the pilot study will be evaluated to identify the variables affecting the UV pilot plant performance, and establish the required basis of design parameters for design of a full-scale UV system. Lonza's current schedule indicates that Product 5024 (with TRIS) will be currently under production with the last harvest day scheduled for August 6, 2005. Product 5023 (with HEPES) will then be back in production with the first harvest day scheduled for August 21, 2005.

A series of "runs" will be established to approximate the range of operating conditions expected for the full scale system with a majority of the runs performed at a worst case condition. UV dosage will be controlled by varying the UVT which will affect the applied UV dosage. A worst case UVT value of 60% has been assumed for the initial baseline condition based on experience with wastewater UV systems in the region. The UVT will be lowered to 60% using a 40% by weight coffee solution. The baseline UV dosage for this testing has been estimated as 35 mJ/cm<sup>2</sup>, to achieve the disinfection performance goals.

The following UV pilot parameters will be evaluated:

- UVT variation of the influent to the UV Disinfection Unit as measured by a UV transmittance meter
- UV Intensity as measured by on-line UV lamp sensor(s)
- Ease of operation and maintenance

A series of controlled runs will be used to evaluate the effectiveness of the UV pilot under varying conditions, as outlined below. Runs will be performed both with the Product 5024 harvesting events in July and early August and Product 5023 harvesting events starting in late August.

#### Runs # 1 and #6 - Baseline Operating Conditions

Initially the pilot will be set up to provide an applied UV dosage of  $35\text{mJ}/\text{cm}^2$  at an assumed UVT value of 60%. Over a period of 2 weeks during Product 5024 and 2 weeks during Product 5023, the baseline performance of the pilot will be assessed by monitoring the effluent quality in terms of *Fecal coliform* and *enterococci* and observed UVT values. This will allow the impact of “normal” variations in UVT above and below the UVT value of 60% on the effectiveness of the system over that range of values to be observed. Depending on the actual UVT values observed, the baseline operating conditions may be adjusted in the field by varying the UVT.

Duration:	2 weeks, 2-hr continuous operation, 5 days/wk and occasional operation on weekends
Purpose:	Develop stable continuous operating conditions and collect initial baseline monitoring data for the pilot plant.
Operating Conditions:	150 gpm flow or as calculated to achieve minimum applied dosage of $35\text{ mJ}/\text{cm}^2$ at an assumed UVT value of 60%.

#### Runs #2 and #7 - Short term runs for flow (dose) variation

Runs #2 and # 7 will not be performed at this point in time.

#### Runs # 3 and #8 - UVT variation

Duration:	Selected runs of 1-2 hrs each for total of 4 trial UVT conditions.
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Purpose: To observe the pilot system disinfection performance for *Fecal Coliform* at varying UVT values in the plant secondary effluent wastewater that may occur during the pilot study. This will be done approximately 24 to 36 hours after the first day of a Product 5024 harvesting event and approximately 24 to 36 hours after the first day of a Product 5023 harvesting event. These runs will be used to identify the applied UV dosage required to meet the prescribed *Fecal Coliform* limits at UVT values between 50 to 75%.

Operating Conditions: Base pilot system dose equivalent to  $\sim 35 \text{ mJ/cm}^2$  (to be estimated at time of pilot). Perform 4 trial runs at “low” UVT conditions observed in the field in the range of 50 to 75%. These runs will be used to confirm the applied UV dosage required to meet the prescribed *Fecal Coliform* limits at UVT values below the assumed baseline value of 50%, thus confirming the highest probable UV dosage required to achieve the prescribed E-coli limits in a full scale system at low UVT values.

Runs # 4 and #9 - Short term runs for variable TSS

Runs #4 and #9 will not be performed at this time.

Runs #5 and #10 - “Normal” operating conditions

Duration: Remainder of pilot test period, 6 weeks, 2-hrs continuous operation, 5 days/wk plus some weekend operations based on plant stressing information. Efforts will be made to identify sampling events over this period with and without the TRIS or HEPES compounds.

- Purpose: To gain experience operating and maintaining the system over an extended test period, monitor UVT and UV intensity sensor accuracy over time, and observe possible sleeve fouling while treating Pease secondary effluent wastewater.
- Operating Conditions: Provide a dose equivalent of  $\sim 35 \text{ mJ/cm}^2$  at simulated design peak flow rate adjusted for the UVT value shown to be appropriate from UVT values observed during earlier testing.

#### Additional Tests to Be Performed By City

- A minimum of four bench scale jar tests will be performed. Two will be performed during the time when Product 5023 with HEPES is present and two during the time when Product 5024 with TRIS is present. These tests should be performed on wastewater samples taken just prior to the ammonia addition point. The testing should be with chlorine as the disinfectant at the levels typically used by the treatment plant and fecal coliforms should be measured as well as the chlorine demand exhibited by the samples to determine performance. During the time of sample collection for this jar testing, fecal coliform samples should also be taken on the UV pilot.
- Once per week during the UV pilot, UVT samples should be taken hourly with a 24-hour discrete sampler to develop a diurnal variation in effluent UVT. Weekend samples should also be collected twice during the pilot testing to evaluate diurnal variations during the weekend operating periods.